September 1995 Highlights of the Pulsed Power Inertial Confinement Fusion Program

Schematic of extraction (PBFA-X) mode. An extraction ion diode is connected to the end of a magnetically insulated transmission line extension installed from the accelerator center.

We are preparing a new technical contract. Plans for the high yield target physics (HYTP) project include 1) develop the target database via experiments on Saturn, Nova, PBFA X, and PBFA Z and 2) improve computational design and diagnostic capability for indirectly driven targets. We will address ignition and high yield issues with z-pinch-driven hohlraums as well as with hohlraums driven by lasers and ion beams. Plans for the ion beam generation and transport (IBGT) project include 1) test extraction ion diode operation at high voltage for energy and defense applications, 2) assess advanced electrode cleaning techniques and active lithium ion sources, and 3) demonstrate self-pinched ion beam transport on SABRE at SNL and on Gamble II at NRL. Research on low-voltage extraction ion diodes at NRL, Cornell University, Osaka University, and the Karlsruhe Research Center will continue to guide development of the PBFA-X diode.

Preparations continued to study ion beam generation in the extraction (PBFA-X) mode on PBFA II (see figure). The first extraction ion diode shot was September 29. These experiments are in a new regime of extraction diode operation: the operating voltage is 5 MV for SABRE and 1.7 MV for KALIF (at Karlsruhe), whereas the present peak voltage of PBFA X in the low voltage mode is 8 MV.

We are continuing to develop the lithium EMFAPS (Evaporating Metal Foil Anode Plasma Source), which at present uses a plasma opening switch (POS) to deliver energy to the anode prior to arrival of power at the diode gap, and we are evaluating differences between this active source and passive LiF sources. Spectroscopy has already shown anode plasma is present near the start of the power pulse, possibly preformed, whereas for the passive LiF field-desorption source, no plasma is present until 15 ns into the pulse. Active sources are particularly susceptible to desorption of surface and substrate impurities since significant lithium is not desorbed until 1200 °C, 3 - 5 times the temperature at which contaminants desorb. Although the POS drive is adequate for initial experiments, it is hard to control the following simultaneously: sufficient current conduction, rapid switch opening, and preventing POS plasma from entering the diode. Work is beginning on an external pulser drive to provide arbitrary timing control and current heating of the Mo overcoat and LiF film that is independent of diode operating characteristics.

We hosted an interlaboratory (SNL, LLNL, LANL) workshop to discuss the relevance to National Ignition Facility (NIF) target design of proposed “foot physics” experiments with z-pinch-driven hohlraums on the Saturn and PBFA-Z pulsed-power accelerators and with laser-driven hohlraums on Nova. Saturn experiments, scheduled to begin in December, will be in the low temperature, low pressure regime where opacities and equations of state are not well known. The generation and propagation of the first shocks in a target ablator have a strong effect on fuel capsule performance. Initial foot physics experiments will use “scale-3” (5mm x 8 mm) hohlraums--*i.e.*, NIF-sized hohlraums. Shock breakout time will be measured using the active diagnostic developed on Saturn, and data will be compared with LASNEX predictions. In addition to setting the fuel adiabat, generation and propagation of shock waves during the foot of the NIF drive pulse is important because Rayleigh-Taylor instabilities are initiated during this period.

Contact: Jeff Quintenz, Inertial Confinement Fusion Program, Dept. 9502, 505-845-7245, fax: 505-845-7464, email: jpquint@sandia.gov
Highlights are prepared by Mary Ann Sweeney, Dept. 9541, 505-845-7307, fax: 505-845-7890, email: masween@sandia.gov.
Archived copies of the *Highlights* beginning July 1993 are available at http://www.sandia.gov/pulspowr/hedicf/highlights.